

# Genetic Resources: Vital Software for Food, Health and Security

USDA Agricultural Outlook Forum

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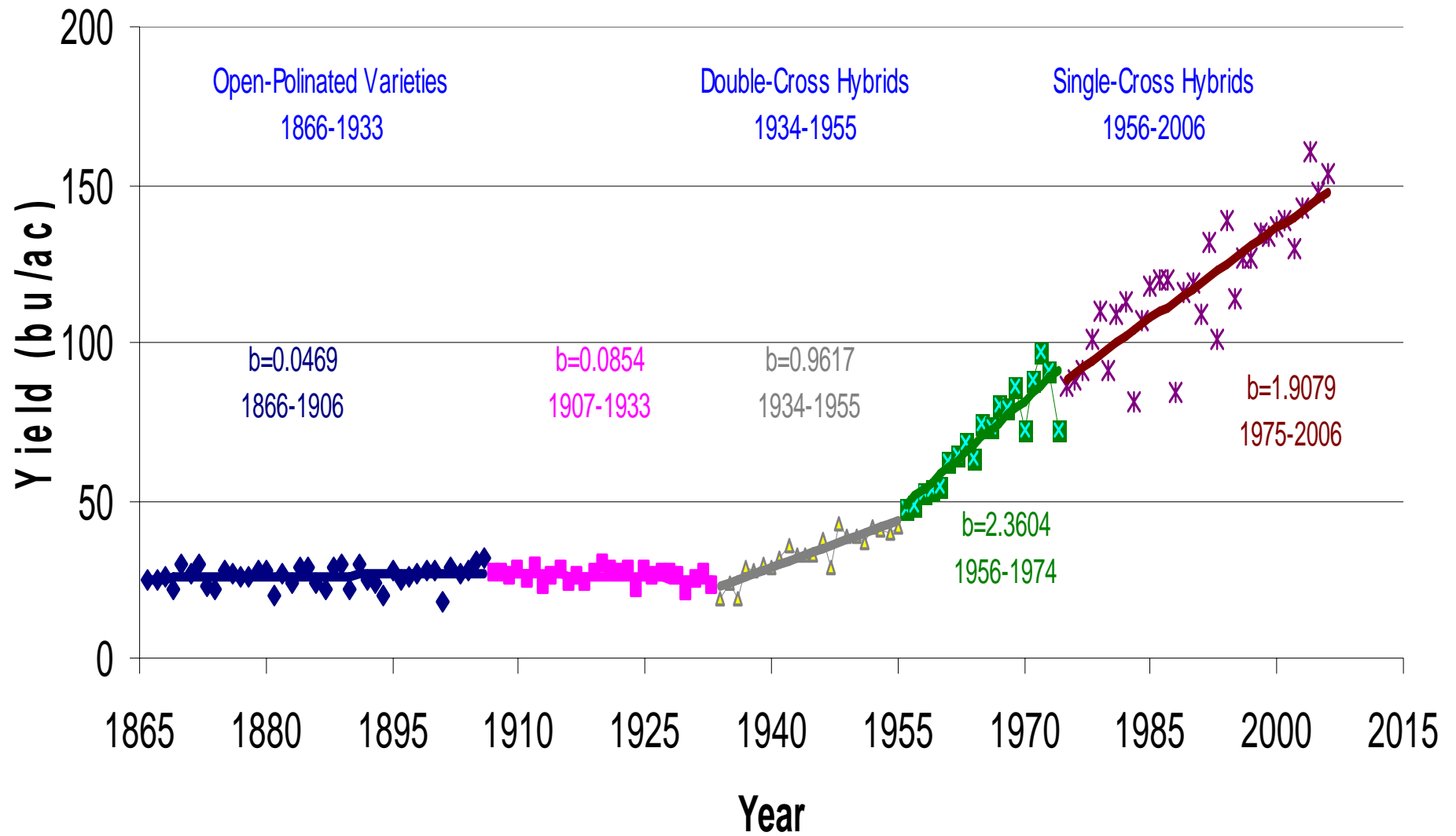
DuPont Agriculture and Nutrition

# Outline

- Planet earth
  - The origins of agriculture: crossing the first threshold
- Increasing agricultural productivity
  - Dramatic and rapid changes in hardware
  - Crossing the second threshold-implications
- Genetic software
  - Biological resources
  - Need for change in productivity and crop husbandry
  - Requirements to allow adaptation and improved productivity
  - Vulnerabilities of a closed system
- Concluding comments
  - Needs for stewardship and appropriate use of biological resources



# U.S. Corn Yields (1866-2006)







Fowler 15226 Tiny Tim

Barry Finch photo









# The second threshold in agriculture

- The first threshold
  - Domestication of crop plants
  - Co-dependence of crop species and humankind
- The second threshold
  - Scientific plant breeding
  - Farmers specialize in production
  - Breeders specialize in varietal improvement
- Implications
  - Conservation-stewardship
    - Germplasm lost forever unless conscious efforts to undertake
  - Dependence on successful sourcing of genetic diversity; global scope

**Left 1990s**

**Right 1930s**





# ECB2, Natural Infestation

1940s Inbred

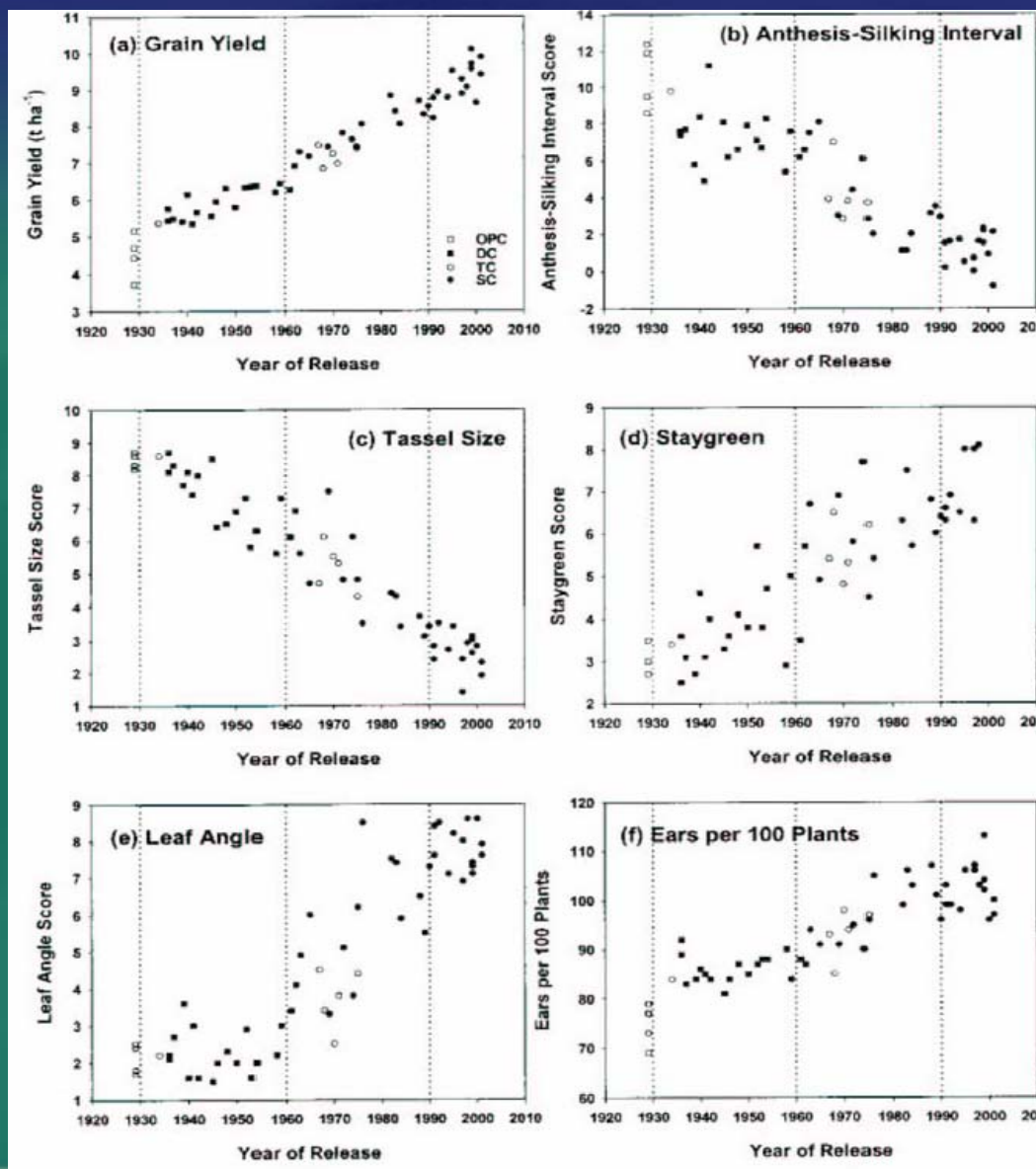


1970s Inbred



# Changes in Other Traits

- 51 hybrids, 4 OPCs
- 1991-2001(BLUPs)
- *Increased yield*
- *Reduced ASI*
- *Reduced tassel size*
- *Improved staygreen*
- *Leaves more upright*
- *More ears/100 plants (fewer barren)*



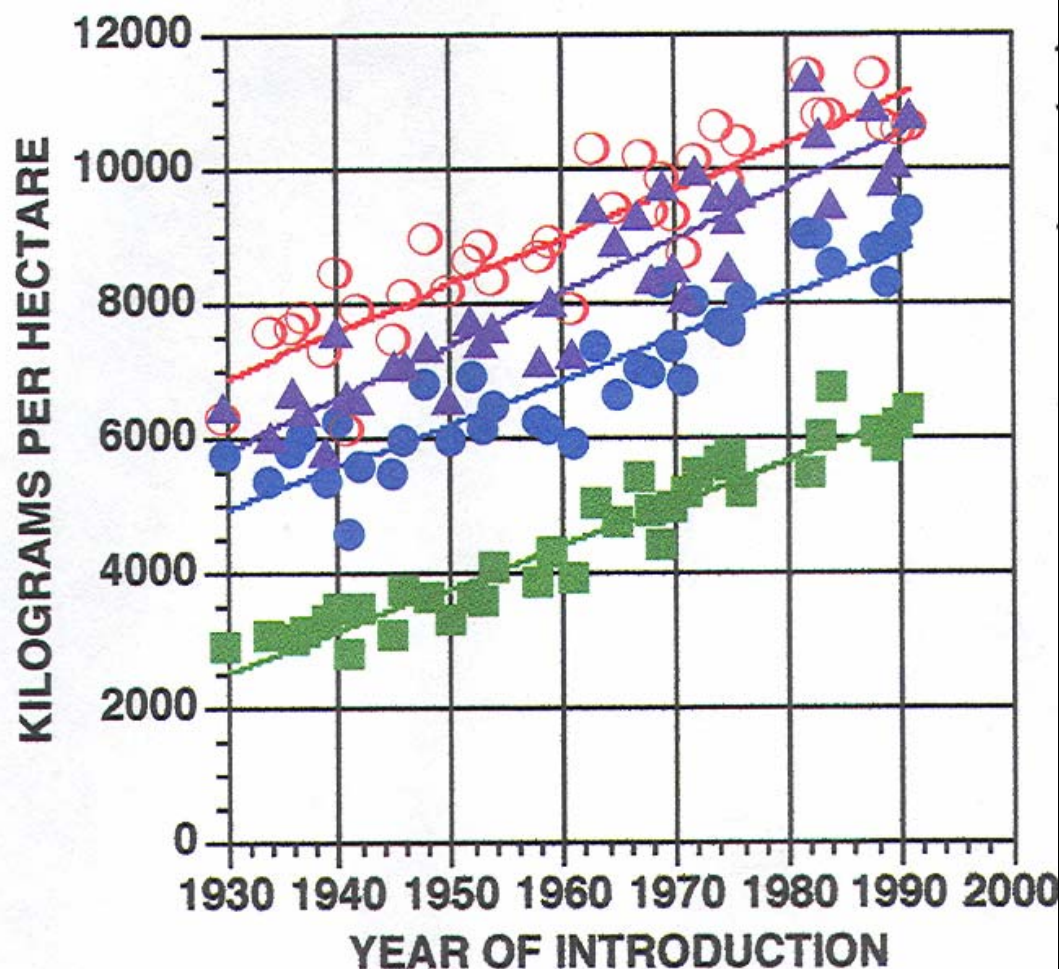
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# Grain Yield in 4 Seasons contributed by genetic software

Yields plotted as “optimum density per hybrid”



- 1992: favorable
- 1994: favorable
- 1991: hot & dry
- 1993: wet & cool
  - “year of the floods”
- ***Linear gains in every season, good or bad***

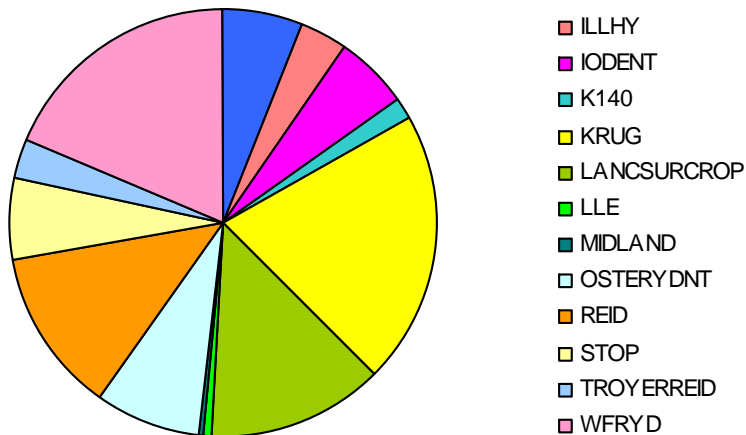


# 1990s Hardware and Software 1930s

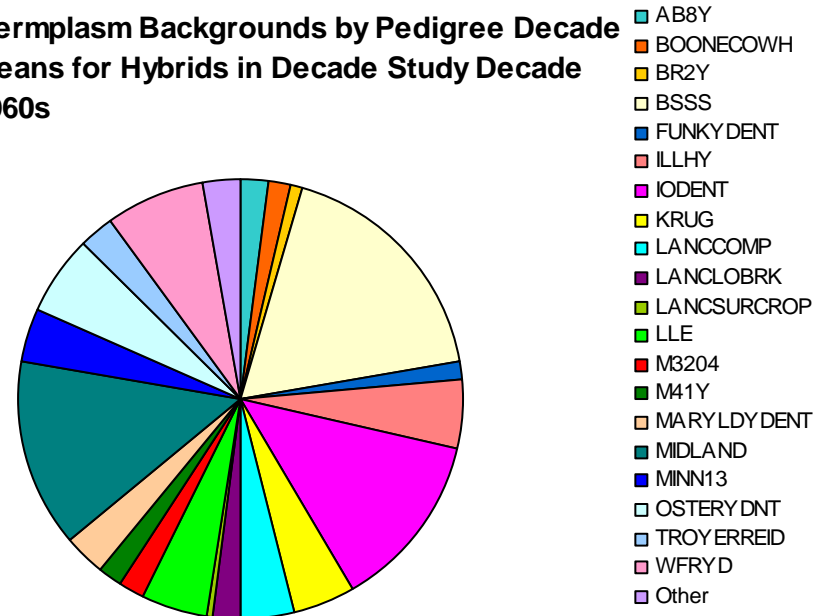


# Genetic software changes

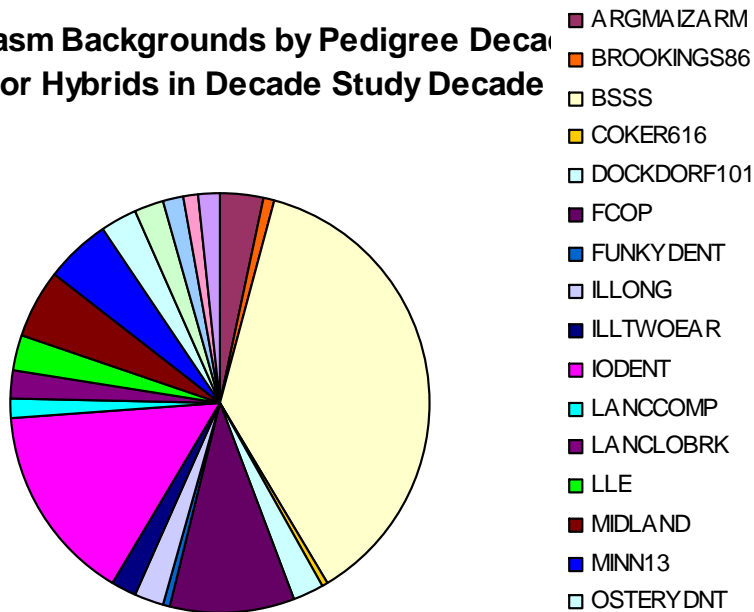
**Germplasm Backgrounds by Pedigree Decade**  
Means for Hybrid in Decade Study Decade  
**1940s**



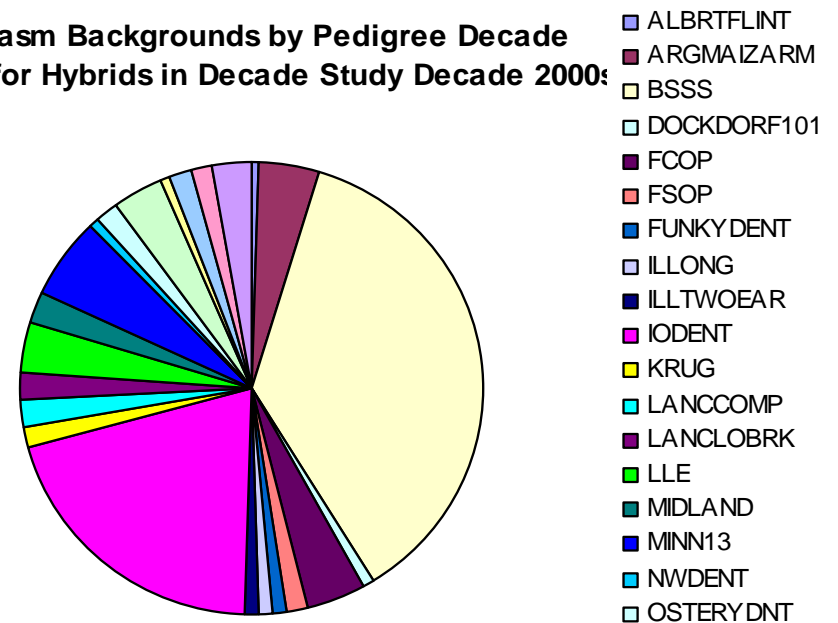
**Germplasm Backgrounds by Pedigree Decade**  
Means for Hybrids in Decade Study Decade  
**1960s**



**Germplasm Backgrounds by Pedigree Decade**  
Means for Hybrids in Decade Study Decade  
**1980s**



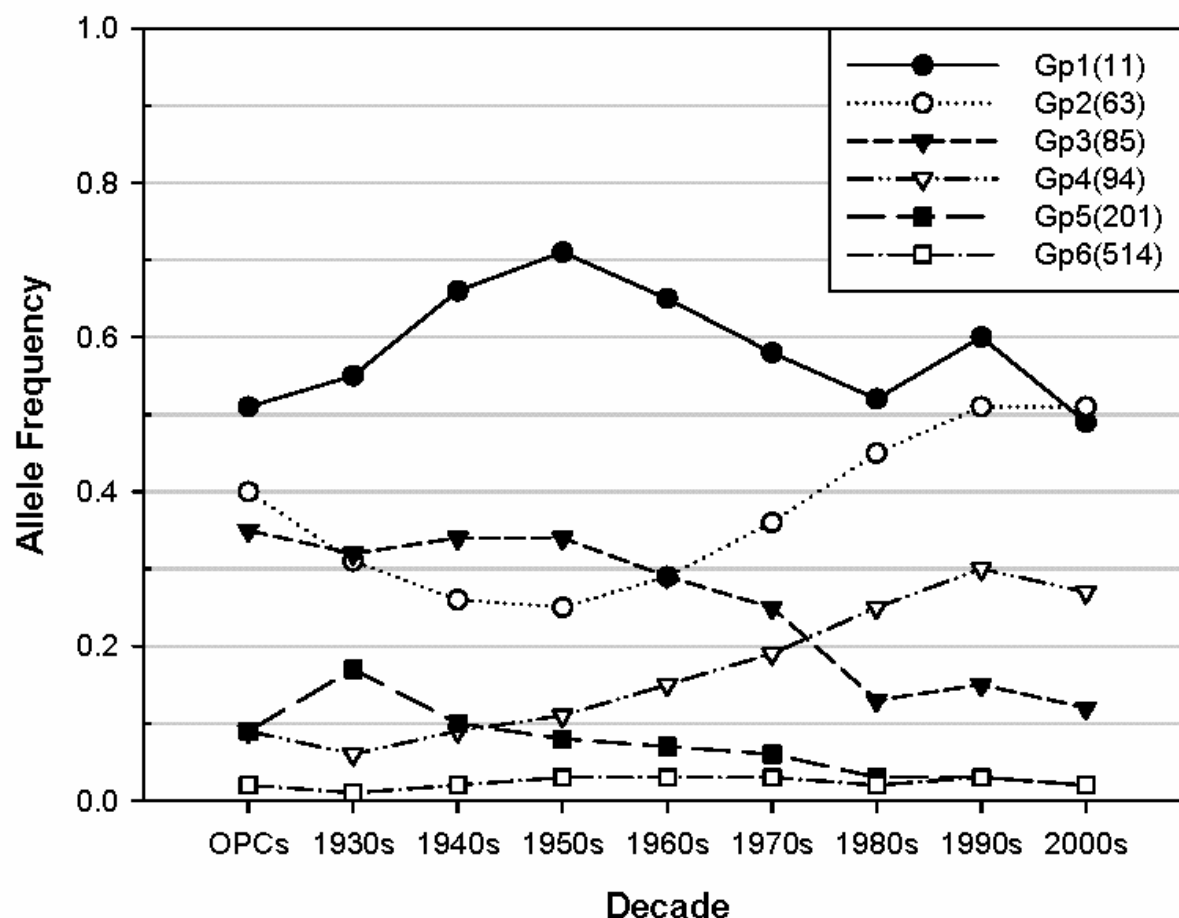
**Germplasm Backgrounds by Pedigree Decade**  
Means for Hybrids in Decade Study Decade  
**2000s**





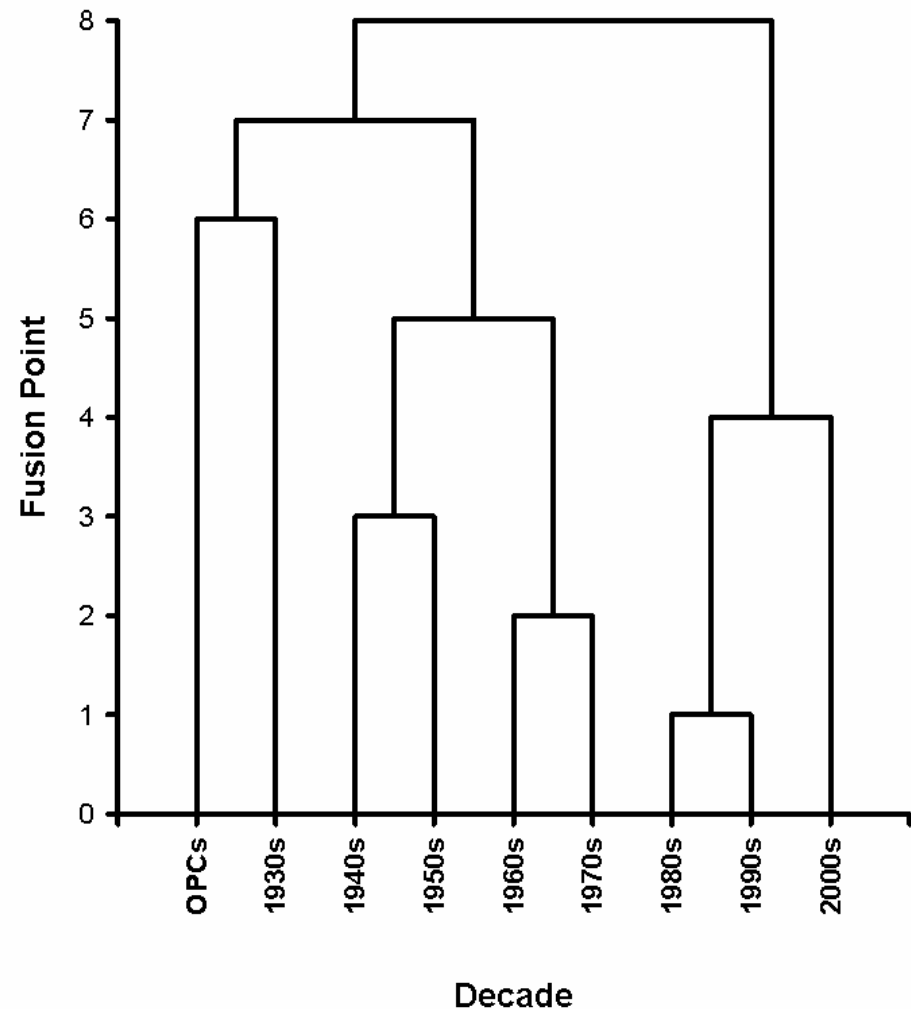
# Genetic software: Change in SSR Alleles

- From ERA hybrids
- 968 SSR alleles from 98 SSR loci distributed over 10 chromosomes
- *Six groups based on mean allele frequency per decade*



# Genetic software: Sequential Change in SSR Alleles

- *The 3 recent decades (since 1980) differ from the earlier decades*
- *Subgroups of early decades*
  - *OPCs & 1930s*
  - *1940s & 1950s*
  - *1960s & 1970s*



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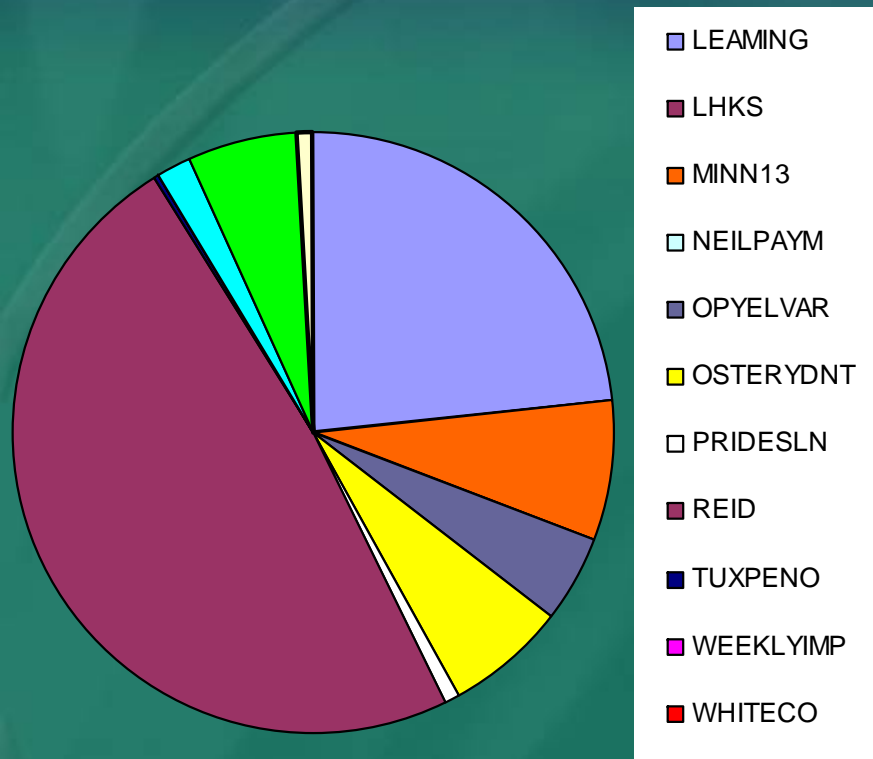


# Pedigree breeding and genetic diversity

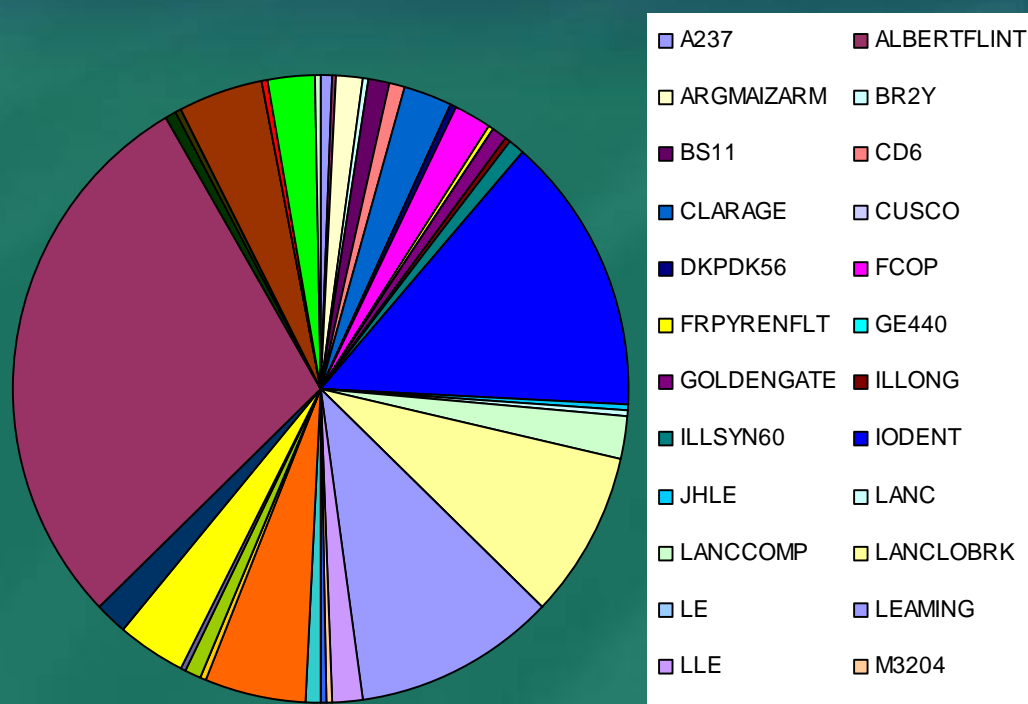
- “The general practice of using good hybrids as source material for the development of new lines insures that there will be a gradual reduction in the total genetic base.”

U.S. National Academy of Sciences 1972

## Public Lines 1985



## Public and Private Lines 2006



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# Evolution of North American Dent Corn from Public to Proprietary Germplasm.

- “Much of today's germplasm originates from seven progenitor lines: B73, LH82, LH123, PH207, PH595, PHG39, and Mo17.”
  - Mark Mikel and John Dudley (Univ. of Illinois)

# Concluding comments

- **Genetic software is a key biological resource**
  - Requiring
    - Stewardship
      - Conscious efforts to conserve
      - Monitoring
    - Transparency
      - allowing farmers to manage through informed choice
    - Global perspective
      - Breeding
      - Conservation
      - Benefit sharing